ERCB Energy Resources Conservation Board

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Directive 081

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November 21, 2012

Water Disposal Limits and Reporting Requirements for Thermal In Situ Oil Sands Schemes

The Energy Resources Conservation Board has approved this directive on November 21, 2012.

<original signed by>

Dan McFadyen
Chair

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1 Purpose of this Directive

This directive consolidates various aspects of water management requirements for thermal in situ oil sands operations. It sets water disposal limits and includes detailed requirements for reporting injection facility water streams to PETRINEX to ensure that Energy Resources Conservation Board (ERCB) facility water balance requirements are met. The disposal limits requires operators to recycle produced water efficiently and ensure that make-up water is effectively used. Efficient water treatment, recycle, and disposal at thermal operations will optimize overall water use and energy efficiency.

In addition to limiting disposal, this directive provides formulas—for water make-up, water productivity ratios, and produced-water recycle—that will be used for monitoring and comparing thermal operations in Alberta. These formulas, along with scheme volumetric data, will be published on the ERCB website.

The ERCB will review the requirements of this directive regularly and may revise requirements as a result of

- improvements in water treatment, recycle, and steam generating technology;
- changes introduced by operators to field operations and water handling;
- changes in bitumen recovery technology that impact water treatment, recycle, and disposal;
- policy and regulatory changes introduced by other government agencies; and
- alignment with other ERCB directives.

The ERCB has also compiled and defined a list of terms used in this directive to provide clarity and to make the information in the directive more accessible (see Appendix A).

2 What's New in this Directive?

This directive

- replaces *Bulletin 2006-11: Water Recycle, Reporting and Balancing Information for In Situ Thermal Schemes*, and
- supersedes and replaces *Informational Letter (IL) 89-05: Water Recycle Guidelines and Water Use Information Reporting for In Situ Oil Sands Facilities in Alberta*.

The following table lists the requirements in this directive and the reason for their inclusion.

Table 1. What's New in This Directive?

Requirement	This directive	Prior to this directive
Injection facility water balance	Specifies a maximum monthly facility imbalance (see section 4.1).	ERCB *Directive 017: Measurement Requirements for Oil and Gas Operations* does not set a maximum facility imbalance for water.
	Specifies requirements for conducting a monthly water balance on a thermal in situ injection facility (see Appendix B).	The ERCB methodology, rules, and equations used in conducting a water balance on thermal in situ injection facilities could be found in various documents and were made available in meetings with stakeholders.
Exemption from water recycle	Sets a maximum disposal limit for all thermal in situ oil sands schemes where the total water make-up exceeds 500 000 cubic metres (m^3) annually in the absence of produced-water recycle (see section 5).	*IL 89-5* required thermal in situ schemes to recycle produced water if fresh water demand exceeded 500 000 m^3 annually and actively investigate and test recycle technology if demand was under 500 000 m^3 annually.
Disposal limit formula	Optimizes produced-water recycle by limiting disposal based on the quantity of fresh, brackish, and produced water used at the central processing facility (see section 5 and Appendix C).	Most thermal commercial scheme approvals required a minimum annual produced-water recycle rate based on the formula in *Bulletin 2006-11*. The recycle formula did not account for make-up water sources other than those that are fresh.

3 ERCB Requirements and Compliance Assurance

Requirements in this directive are those rules that a thermal in situ oil sands operator is required to follow. The term "must" indicates a requirement, while terms such as "should" and "encourages" indicate a recommended practice.

Noncompliance with any risk-assessed requirement in this directive will result in the operator receiving a response in accordance with the latest edition of ERCB *Directive 019: Compliance Assurance*. Some examples of noncompliance for which the ERCB will take enforcement action are if

- actual water disposal at the scheme exceeds the disposal limit,
- the monthly injection-facility water balance closure is greater than 5.0 per cent for three consecutive months, or
- fresh water is reported as brackish water in PETRINEX.

The ERCB encourages all in situ oil sands operators to be proactive by monitoring their compliance with this directive. If an operator identifies a noncompliance, it should inform the ERCB of the noncompliance for consideration under the ERCB Voluntary Self-Disclosure policy set out in *Directive 019*. For a list of noncompliant events and further details on compliance assurance, including *Directive 019* see the ERCB website www.ercb.ca/safety-and-compliance/compliance-enforcement.

3.1 Compliance with Disposal Limit

For the first twelve months of scheme start-up, the ERCB will not strictly enforce the disposal limit (see section 5). The start-up period is from the commencement of steam injection. Once this twelve-month period is complete, the ERCB will use the remaining

months of that calendar year to calculate the disposal limit to determine compliance for that year. The start-up grace period does not apply to scheme expansions.

The ERCB will consider variations of the disposal factors in Table 2 of section 5 upon application in cases where high produced-water rates or high concentration of total dissolved solids (TDS) in make-up water make it difficult to meet the disposal limit (e.g., water-to-steam ratio exceeds 1.05 or TDS exceeds 15 000 mg/L). It is the operator's responsibility to justify any deviation from the requirements in section 5.

4 Water Reporting and Facility Water Balance

4.1 Injection Facility Monthly Water Balance

The ERCB equation for monthly water imbalance on an injection facility is provided in Table B3 of Appendix B. This monthly imbalance will correspond to the balancing activity "DIFF" for the product group "WATER" in the "Summary" view for an injection facility in PETRINEX. The monthly imbalance must not exceed 5.0 per cent for three consecutive months or more.

Accurate water measurement is needed in order to meet the injection facility monthly imbalance requirement and to reliably calculate the disposal limit (section 5.2) and actual disposal (section 5.3). Water measurement requirements for thermal in situ oil sands operations are set out in sections 12.3 and 12.4 of *Directive 017: Measurement Requirements for Oil and Gas Operations*.

4.2 Reporting to PETRINEX

Operators must report monthly water streams to PETRINEX in accordance with the definitions and equations in Appendix B.

The data are used by the ERCB to determine compliance with the maximum injection facility imbalance of 5.0 per cent (see section 4.1) and with the annual scheme disposal limit (see section 5 and Appendix C). The correct reporting of water is also necessary in order to monitor and evaluate the performance of each scheme. To help ensure that water volumes are correctly reported to PETRINEX, examples of the required PETRINEX reporting of water and the required water balance calculations have been included in the appendices of this directive and are described below. For each example, the steam volume is reported in cold water equivalent.

1) Appendix D provides a simplified water-flow diagram with PETRINEX reporting codes and required metering for a sample thermal scheme. The appendix also illustrates the boundary between a battery and injection facility for the purpose of reporting to PETRINEX (i.e., produced water leaving a battery requires no further hydrocarbon separation.)

2) The required reporting of the sample scheme water volumes from Appendix D to the correct PETRINEX codes is provided in tabular form in Appendix E.

3) Appendix F displays the resulting PETRINEX screen shots for the sample scheme facilities in Appendix D to illustrate what the "Summary", "Facility Activity", and "Well Activity" views of PETRINEX would look like for the reporting requirements in Appendix B.

4) For the same sample scheme facilities, Appendix G shows how the correctly reported water volumes from PETRINEX are used to generate a monthly water balance, using the required equations from Table B3, Appendix B.

5 Formulas and Limits for Disposal at Thermal In Situ Schemes

This section establishes a maximum water disposal limit for each thermal in situ operation in Alberta. The maximum disposal limit is intended to ensure efficient recycling of a scheme's produced water and to promote energy efficiency.

Effective immediately, the maximum water disposal limit applies to all new schemes. For existing schemes, the maximum water disposal limit will become effective either

- when the licensee applies to expand a scheme's bitumen processing or steam generation capacity (applied to the entire scheme within the time frame stated in the approval), or
- three years from November 21, 2012, unless a shorter period is applied for by the operator.

The effective date of the maximum disposal limit will be whichever date occurs first.

The limits set out in this section do not apply to thermal in situ oil sands schemes that, in the absence of produced-water recycle, have a total annual volume of make-up water less than 500 000 m^3.

5.1 Overview

Water disposal at a scheme is affected by

- the quality and quantity of water streams entering the facilities in the scheme,
- the treatment technologies being used, and
- the bitumen recovery mechanism.

Based on available technologies and bitumen recovery mechanisms, the ERCB has established a disposal allowance for each type of water used at thermal operations. These allowances are entered into the disposal limit formula to determine the maximum disposal limit for the scheme (see section 5.2).

The maximum disposal limit will be enforced against the total annual (calendar year) volumes of water disposal at each scheme. Formulas must be applied on a scheme basis. Schemes with multiple injection and disposal facilities cannot apply these formulas to individual facilities.

For the purpose of this directive, the water types used in the disposal-limit formula are fresh, brackish, and produced, with the recovery mechanisms being steam-assisted gravity drainage (SAGD) and cyclic steam stimulation (CSS). If water types, recovery mechanisms, or treatment technologies change, this directive and its limits will be amended accordingly.

For disposal formulas using ERCB water balance codes, see Appendix C.

5.2 Disposal Limit Formula

The maximum disposal limit for a scheme is calculated as a percentage of the scheme's total inlet water volume:

$$\text{Disposal Limit (\%)} = \frac{\left(\text{Fresh In} \times D_f + \text{Brackish In} \times D_b + \text{Produced In} \times D_p\right)}{\text{Fresh In} + \text{Brackish In} + \text{Produced In}} \times 100$$

where

Fresh In = the annual volume of inlet fresh water in m^3 for the scheme from volumes reported in PETRINEX.

Brackish In = the annual volume of inlet brackish water in m^3 for the scheme from volumes reported in PETRINEX.

Produced In = the annual volume of inlet produced water in m^3 for the scheme from volumes reported in PETRINEX.

D_f = the disposal factor for fresh water.

D_b = the disposal factor for brackish water.

D_p = the disposal factor for produced water.

Table 2 provides the disposal factors for the recovery mechanism used in the scheme.

Table 2. Disposal factor by thermal in situ recovery mechanism

Disposal factor	Inlet water type	SAGD	CSS
D_f	Fresh water	0.03	0.03
D_b	Brackish water	0.35	0.35
D_p	Produced water	0.10	0.07

5.3 Actual Disposal Formula

The actual disposal formula gives the total scheme disposal as a percentage of the scheme's total inlet water volume:

$$\text{Actual Disposal (\%)} = \frac{\text{Total Disposal}}{\text{Fresh In} + \text{Brackish In} + \text{Produced In}} \times 100$$

where

Total Disposal = the annual volume in m^3 of scheme water injected into designated disposal wells and annual volume of scheme water delivered out of the scheme.

Fresh In = the annual volume of inlet fresh water in m^3 for the scheme from volumes reported in PETRINEX.

Brackish In = the annual volume of inlet brackish water in m^3 for the scheme from volumes reported in PETRINEX.

Produced In = the annual volume of inlet produced water in m^3 for the scheme from volumes reported in PETRINEX.

The scheme's actual disposal must not exceed the limit calculated by the disposal limit formula.

6 Data Publication

Coincident with the release of this directive, a new interactive publication—Thermal In Situ (TIS) Water Publication—of monthly and annual water usage at all commercial thermal in situ schemes is available on the ERCB website. The publication includes water disposal limits and actual water disposal (sections 5.2 and 5.3), and additional scheme performance indicators (Appendix H). The data used in the publication can be exported by users to an Excel spreadsheet. The publication may be amended from time to time to include additional performance indicators and data.

Summary of Appendices

Appendix A Definitions

Appendix B Facility Water Balance Requirements

Table B1 provides PETRINEX reporting requirements for monthly water streams entering and leaving a facility, and includes

- definitions of terms, and
- allowable water sources for each ERCB material balance code and corresponding PETRINEX reporting entity.

Table B2 provides PETRINEX reporting requirements for monthly water inventory changes at facility water storage tanks and ponds. PETRINEX reporting entities have corresponding ERCB water balance codes.

Table B3 provides the ERCB facility water balance equation using ERCB codes from Tables B1 and B2.

Where ERCB water balance codes and corresponding PETRINEX reporting entities represent calculated values, the calculation methods are provided.

Appendix C Disposal Formulas using ERCB Water Balance Codes: Presents the disposal limit and actual disposal formulas from section 5 using the ERCB water balance codes listed in Appendix B.

Appendix D Sample Scheme Simplified Water Flow Diagram with PETRINEX Reporting Codes and Required Metering. A simplified water-flow diagram for an example thermal in situ oil sands scheme. The diagram is in a format that reflects PETRINEX reporting requirements and metering locations.

Appendix E Sample Scheme PETRINEX Reporting Requirements: A table containing the required water stream PETRINEX reporting codes for the example facilities AB IF 0000003 and AB IF 0000002 in Appendix D.

Appendix F Sample Scheme PETRINEX Reporting Requirements (PETRINEX Screen Shots): PETRINEX screenshots of data submissions for example facilities AB IF 0000003 and AB IF 0000002.

Appendix G Sample Scheme Facilities Monthly Water Balance: Water balance requirements for sample facilities AB IF 0000003 and AB IF 0000002 in Appendix D.

Appendix H Additional Scheme Performance Indicators using ERCB Water Balance Codes: Formulas used by the ERCB to assess scheme performance and to compare schemes.

Appendix A Definitions

Battery

A system or arrangement of tanks or other surface equipment receiving the effluent of one or more wells prior to delivery to market or other disposition, and may include equipment or devices for separating the effluents into oil, gas or water and for measurement.

Boiler blowdown

Boilers used in thermal recovery processes typically produce steam with a quality between 75 and 80%. This results in 20 to 25% of the boiler feed water not being vapourized, and in steam-assisted gravity drainage (SAGD) schemes, the resulting liquid is separated from the steam. This separated water stream leaving the boiler is called blowdown and contains more concentrated total dissolved solids, typically 4 to 5 times more, than the boiler feed water.

Brackish water (saline groundwater)

For the purpose of this directive and for reporting to PETRINEX, brackish water is saline groundwater defined in Part 1(1)(z) of the Alberta *Water (Ministerial) Regulation* as "water that has total dissolved solids exceeding 4000 milligrams per litre." Such groundwater is defined as "brackish water" in PETRINEX and "saline groundwater" by Alberta Environment and Sustainable Resource Development.

Camp

For the purpose of this directive, a camp is a residential housing facility for construction and operations workers associated with a thermal injection scheme.

Cold water equivalent (CWE)

All produced and injected water and steam volume measurements are corrected to a standard temperature of 15°C and 101.325 kilopascals absolute and reported in m^3.

Existing scheme

A scheme that has received ERCB approval before the issuance of this directive, even if not yet constructed.

Fresh water (nonsaline groundwater or surface water)

For the purpose of this directive and for reporting to PETRINEX, fresh water is either nonsaline groundwater, which is groundwater that has total dissolved solids less than or equal to 4000 milligrams per litre, or surface water, which is as defined in Part 1(1)(bb) of the Alberta *Water (Ministerial) Regulation* as "all water on the ground surface, whether in liquid or solid state."

A freshwater source may refer to

- a well licensed by the ERCB drilled to a depth of greater than 150 m;
- a shallow well with a depth of less than 150 m;
- a surface water source, such as a diversion point at a lake or a river (regardless of TDS); or
- surface runoff collected.

Regardless of the source, all freshwater use requires a diversion licence from ESRD in accordance with the *Water Act*.

Injection facility

A system or arrangement of surface equipment associated with the injection or disposal of any substance through one or more wells.

Make-up water	Water used at thermal in situ operations other than produced water from wells within the scheme. This water must make up for water losses such as the disposal of water treatment waste streams, boiler blowdown, and reservoir retention of injected steam.
New scheme	A scheme that did not receive ERCB approval before the directive was issued.
PETRINEX	PETRINEX is a web-based system that provides management/exchange of volumetric, royalty, and commercial information associated with the upstream petroleum sector for the Provinces of Alberta and Saskatchewan.
Produced water	Water that is produced in association with hydrocarbon production from a well that was licensed for the purpose of hydrocarbon production.
Scheme	For the purpose of this directive, a scheme includes all batteries and injection facilities associated with an ERCB thermal in situ oil sands scheme approval.
Steam	For reporting to PETRINEX, the sum of all steam injection of varying quality, reported in cold water equivalent.
Water balance	A series of calculations the ERCB uses on water volume data that are reported to PETRINEX to give the ERCB an indication of measurement and reporting accuracy for a facility. The water balance identifies all water types and water uses, and determines the imbalance between the total input and total output streams.

Appendix B Facility Water Balance Requirements

(ERCB *Directive 017: Measurement Requirements for Oil and Gas Operations* specifies measurement requirements for the water streams in Table B1.)

Table B1: Water Stream (In and Out) Reporting, Definitions, and Allowable Sources

Water stream	PETRINEX activity	PETRINEX product	ERCB water balance code	Definitions and allowable water sources
WATER IN				
Fresh	REC/PROD	FSHWTR	FW1	The sum of all "Fresh" water streams into a facility, not including transfers from facilities within the scheme. Allowable sources include • wells licensed by ESRD and the ERCB (AB WI),[a] • a water battery facility (AB BT) (902),[b] • wells and locations (e.g., rivers, lakes) licensed only by ESRD (AB WS) (901),[b] • site runoff (AB RO),[b] • an oil sands project (AB OS), and • other sources (AB MC), such as camp wastewater In accordance with the *Water Act*, all fresh water use requires a diversion permit from ESRD, regardless of the source.
Fresh Transfer	REC	FSHWTR	FW2	The sum of all "Fresh" water streams transferred into a facility from other facilities within the scheme. Allowable sources include • another injection facility (AB IF), • a battery facility (AB BT), or • an oil sands project (AB OS) (i.e., an integrated upgrader)
Brackish	REC/PROD	BRKWTR	BW1	The sum of all "Brackish" water streams into a facility, not including transfers from facilities within the scheme. Allowable sources include • ERCB-licensed wells (AB WI)[a] • a water battery facility (AB BT) (902),[b] or • other sources (AB MC)
Brackish Transfer	REC	BRKWTR	BW2	The sum of all "Brackish" water streams transferred into a facility from other facilities within the scheme. Allowable sources include • another injection facility (AB IF), or • a battery facility (AB BT).
Produced	REC	WATER	PW1	The sum of all "Produced" water streams into a facility, not including transfers from injection facilities within the scheme. Sources must originate from wells within the scheme. Allowable sources include • a battery facility (AB BT) (344), or • other sources (AB MC), such as a pipeline leak.

(continued)...

[a] Reported as "PROD" in PETRINEX.
[b] Reported as "REC" in PETRINEX.

Water stream	PETRINEX activity	PETRINEX product	ERCB water balance code	Definitions and allowable water sources
Produced Transfer	REC	WATER	PW2	The sum of all "Produced Transfer" water streams into a facility from other facilities within the scheme. Allowable source is another injection facility (AB IF).
Steam Total Transfer	REC	STEAM	ST2	The sum of all "Steam Total Transferred" water streams into a facility from other facilities within the scheme. Allowable source is another injection facility (AB IF).
WATER OUT				
Inject Total	INJ	STEAM	INT	"Inject Total" is a calculated PETRINEX value in the summary view. INJ STEAM is the sum of all wells coded as Steam Injection, SAGD, and Cyclic reporting to the AB IF in the well activity view. INT = ∑INJ STEAM
Disposal Total	INJ	FSHWTR BRKWTR WATER	DIT	"Disposal Total" is the sum of the calculated PETRINEX values for all wells coded "Water Disposal" in the well activity view (INJ FSHWTR, INJ BRKWTR, INJ WATER) plus the total water delivered out of the scheme. DIT = INJ FSHWTR + INJ BRKWTR + INJ WATER + ∑DISP (FSHWTR, BRKWTR, WATER)
Fresh PLTUSE	PLTUSE	FSHWTR	FW6	"Fresh" water streams used for purposes other than utilities or injection, such as drilling, potable use, and sludge pond losses.
Fresh Transfer	DISP	FSHWTR	FW3	"Fresh" water streams that have been delivered to another facility within the scheme.
Fresh UTIL	UTIL	FSHWTR	FW7	"Fresh" water streams used at the injection facility for utility, waste steam, and emissions control and not recovered due to evaporation or venting.
Brackish PLTUSE	PLTUSE	BRKWTR	BW6	"Brackish" water streams used for purposes other than utilities or injection, such as drilling or sludge pond losses.
Brackish Transfer	DISP	BRKWTR	BW3	"Brackish" water streams that have been delivered to another facility within the scheme.
Brackish UTIL	UTIL	BRKWTR	BW7	"Brackish" water streams used at the injection facility for utility and waste steam and not recovered due to evaporation or venting.
Produced PLTUSE	PLTUSE	WATER	PW6	"Produced" water streams used for purposes other than utilities or injection, such as sludge pond losses.

continued

Water stream	PETRINEX activity	PETRINEX product	ERCB water balance code	Definitions and allowable water sources
Produced Transfer	DISP	WATER	PW3	The sum of all "Produced Transfer" water streams out of a facility to other facilities within the scheme. Allowable destination is another injection facility (AB IF).
Produced UTIL	UTIL	WATER	PW7	"Produced" water streams used at the injection facility for utility and waste steam and not recovered due to evaporation or venting.
Produced Steam/Water to ABBT	DISP	STEAM/ WATER	PW8	"Produced Steam/Water" reported as a "DISP" activity on the injection facility, reported as a "REC" at the source battery (AB BT), used at the battery (heating, utility water, etc.), and returned with the produced water (PW1).
Steam Total Transfer	DISP	STEAM	ST3	"Steam Total Transfer" is an auto-populated PETRINEX value that is the sum of dispositions of steam from the AB IF to other facilities within the scheme. Allowable destination is another injection facility (AB IF).

Table B2: Water Inventory Reporting and Definitions

Inventory type	PETRINEX activity	PETRINEX product	ERCB water balance code	Definitions
Fresh Open	INVOP	FSHWTR	FW4	Freshwater tank or pond opening inventory.
Fresh Close	INVCL	FSHWTR	FW5	Freshwater tank or pond closing inventory.
Brackish Open	INVOP	BRKWTR	BW4	Brackish-water tank opening inventory.
Brackish Close	INVCL	BRKWTR	BW5	Brackish-water tank closing inventory.
Produced Open	INVOP	WATER	PW4	Produced-water tank opening inventory.
Produced Close	INVCL	WATER	PW5	Produced-water tank closing inventory.

Table B3: Facility Water Balance Equations

Activity	Equations using ERCB water balance codes from Tables B1 and B2
IN	(FW1 + FW2 + BW1 + BW2 + PW1 + PW2 + ST2 + FW4 + BW4 + PW4)
OUT	(INT + DIT + FW3 + FW5 + FW6 + FW7 + BW3 + BW5 + BW6 + BW7 + PW3 + PW5 + PW6 + PW7 + PW8+ ST3)
Adjustment	Total Water IN – Total Water OUT
Imbalance (%)	[(Total Water IN – Total Water OUT) / Total Water IN] x 100 This will correspond to the balancing activity "DIFF" for the product group "WATER" in the "Summary" view for an injection facility.

Appendix C Disposal Formulas Using ERCB Water Balance Codes

1) Disposal Limit

$$\text{Disposal Limit (\%) (Scheme Basis)} = \frac{\left(\text{Fresh In} \times D_f + \text{Brackish In} \times D_b + \text{Produced In} \times D_p\right)}{\text{Fresh In} + \text{Brackish In} + \text{Produced In}} \times 100$$

$$= \frac{\left[(FW1 + FW4 - FW5) \times D_f + (BW1 + BW4 - BW5) \times D_b + (PW1 + PW4 - PW5 - PW8) \times D_p\right]}{(FW1 + FW4 - FW5) + (BW1 + BW4 - BW5) + (PW1 + PW4 - PW5 - PW8)} \times 100$$

If multiple injection and disposal facilities exist within a scheme, the above values must be summed for all facilities (e.g., FW1 = $\sum$ FW1 for all injection and disposal facilities).

Disposal Factors for Use in the Disposal Limit Formula

Disposal factor	Inlet water type	SAGD	CSS
D_f	fresh	0.03	0.03
D_b	brackish	0.35	0.35
D_p	produced	0.10	0.07

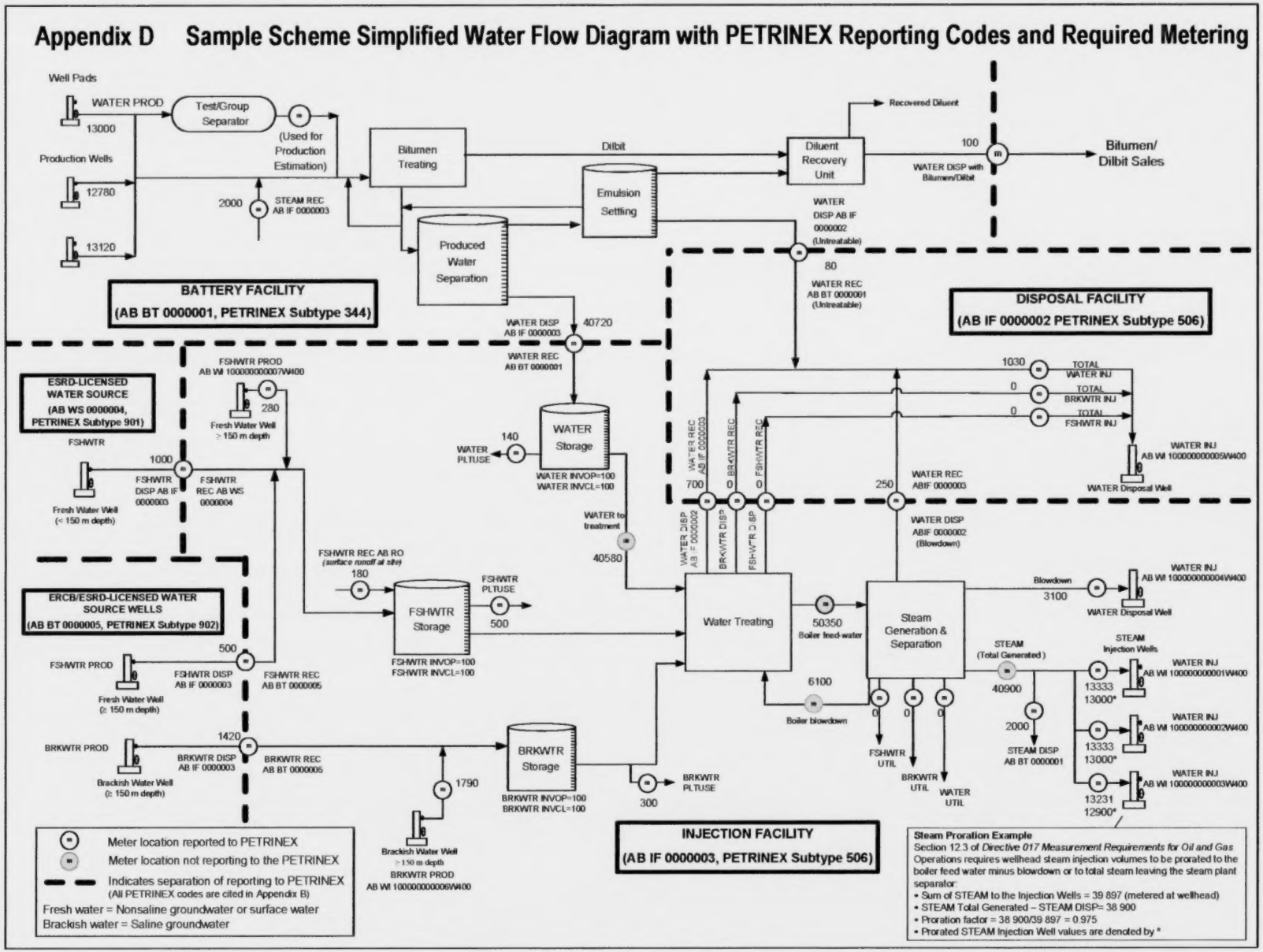
2) Actual Disposal

$$\text{Actual Disposal (\%) (Scheme Basis)} = \frac{\text{Total Disposal}}{\text{Fresh In} + \text{Brackish In} + \text{Produced In}} \times 100$$

$$= \frac{\text{DIT}}{(FW1 + FW4 - FW5) + (BW1 + BW4 - BW5) + (PW1 + PW4 - PW5 - PW8)} \times 100$$

If multiple injection and disposal facilities exist within a scheme, the above values must be summed for all facilities (e.g., DIT = $\sum$ DIT for all injection and disposal facilities).

Appendix D Sample Scheme Simplified Water Flow Diagram with PETRINEX Reporting Codes and Required Metering



Appendix E Sample Scheme PETRINEX Reporting Requirements

(ERCB *Directive 017: Measurement Requirements for Oil and Gas Operations* specifies measurement requirements for the water streams in this table.)

	Injection facility (steam plant) AB IF 0000003		Injection facility (disposal) AB IF 0000002	
Water streams reported to PETRINEX	**In**	**Out**	**In**	**Out**
IN				
Fresh water from on-site well≥150 m depth (FSHWTR PROD AB WI 100000000007W400)	280			
Fresh water from well<150 m depth (FSHWTR REC AB WS 0000004)	1 000			
Fresh water from well≥150 m depth (FSHWTR REC AB BT 0000005)	500			
Fresh water from surface runoff at site (FSHWTR REC AB RO)	180			
Fresh water transfer from injection facility (FSHWTR REC AB IF 0000003)				
Brackish water from on-site well≥150 m depth (BRKWTR PROD AB WI 100000000006W400)	1 790			
Brackish water from well≥150 m depth (BRKWTR REC AB BT 0000005)	1 420			
Brackish water transfer from injection facility (BRKWTR REC AB IF 0000003)				
Produced water from battery facility (WATER REC AB BT 0000001)*	40 720		80	
Produced water transfer from injection facility (WATER REC AB IF 0000003)			950	
OUT				
Steam injection (STEAM INJ AB WI 100000000001W400)		13 000		
Steam injection (STEAM INJ AB WI 100000000002W400)		13 000		
Steam injection (STEAM INJ AB WI 100000000003W400)		12 900		
Blowdown water disposal (WATER INJ AB WI 100000000004W400)		3 100		
Water disposal (WATER INJ AB WI 100000000005W400)				1 030
Fresh water transfer to disposal facility (FSHWTR DISP AB IF 0000002)				
Fresh water for plant use (FSHWTR PLTUSE)		500		
Fresh water for utility, waste steam, etc. (FSHWTR UTIL)				
Brackish water transfer to disposal facility (BRKWTR DISP AB IF 0000002)				
Brackish water for plant use (BRKWTR PLTUSE)		300		
Brackish water for utility, waste steam, etc (BRKWTR UTIL)				
Produced water transfer to disposal facility (WATER DISP AB IF 0000002)		700		
Blowdown water transfer to disposal facility (WATER DISP AB IF 0000002)		250		
Produced water for plant use (WATER PLTUSE)		140		
Produced water for utility, waste steam, etc. (WATER UTIL)				
Steam to battery facility for heating (STEAM DISP AB BT 0000001)		2 000		
INVENTORY				
Fresh water tank opening inventory (FSHWTR INVOP)	100			
Brackish water tank opening inventory (BRKWTR INVOP)	100			
Produced water tank opening inventory (WATER INVOP)	100			
Fresh water tank closing inventory (FSHWTR INVCL)		100		
Brackish water tank closing inventory (FSHWTR INVCL)		100		
Produced water tank closing inventory (WATER INVCL)		100		

* Includes return of 2000 m^3 steam sent to battery facility for heating from AB IF 0000003

Appendix F Sample Scheme PETRINEX Reporting Requirements (PETRINEX Screen Shots)

Sample Scheme: Injection Facility AB IF 0000003

1) Summary View: Product Group "Water"

Menu Inbox Help Contacts Logout AB BA: Name: Quicklist:

[Monthly Reporting] > [Volumetric]

Query Volumetric Submission

Facility ID: AB IF 0000003 **Location:** 00-00-00-000-00 W4 **Production Month:** 2012-09
Name: SAMPLE SCHEME **Amendment #:** 1
Reference Code: ABIF0000003 **Submitted:** 2012-10-16 13:51
ERCB Extracted: 2012-10-19 19:14

View: Summary
Product Group: WATER
Go

Balancing activity	Volume	%
DIFF	0.0	0.0

Product totals: BRKWTR	Volume
Activity	
INVCL	100.0
INVOP	100.0
PLTUSE	300.0
PROD	1790.0
REC	1420.0

Product totals: FSHWTR	Volume
Activity	
INVCL	100.0
INVOP	100.0
PLTUSE	500.0
PROD	280.0
REC	1680.0 ← 1000 + 500 + 180

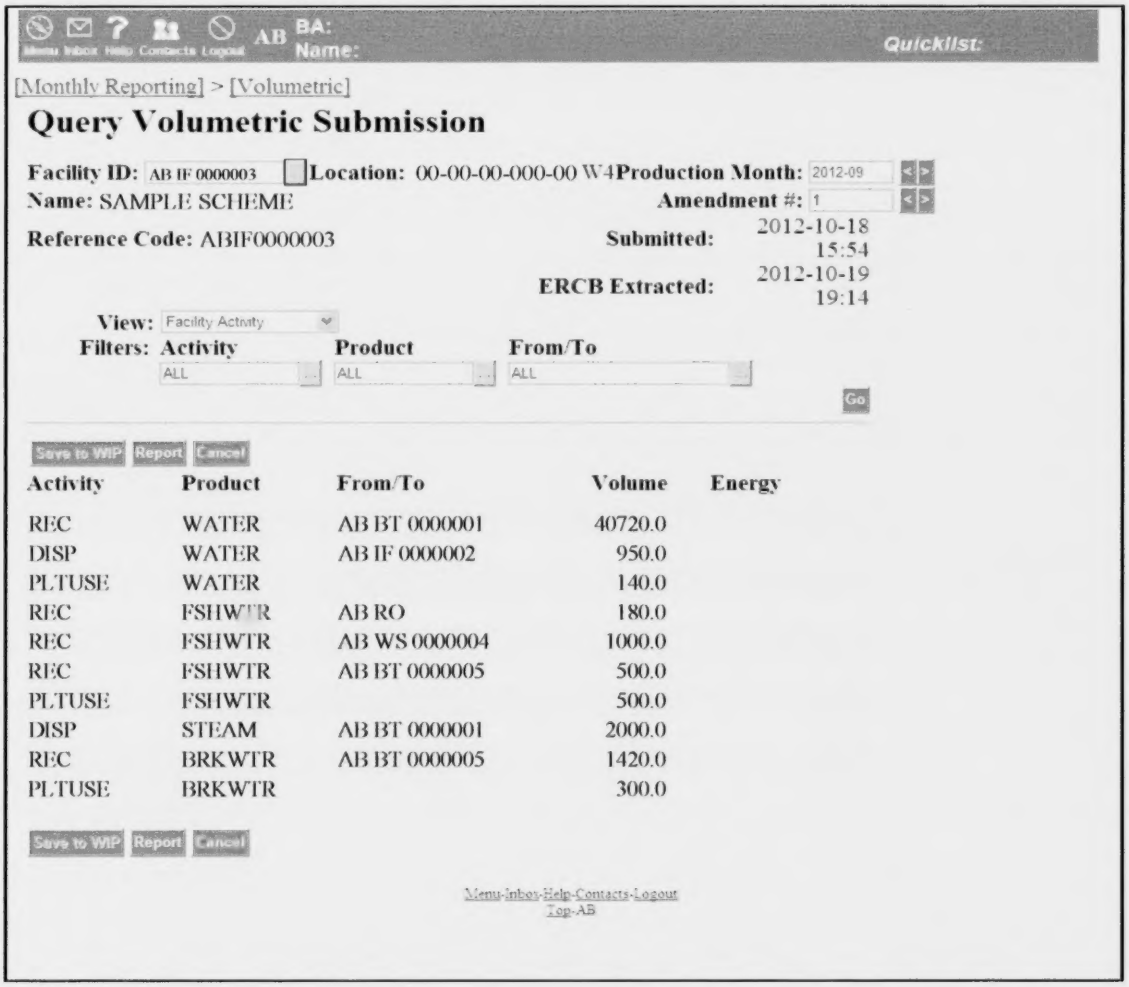
Product totals: STEAM	Volume
Activity	
DISP	2000.0 ← This is steam used to heat battery facilities. If you reported as WATER rather than STEAM this would be a DISP under Product totals: WATER
INJ	38900.0

Product totals: WATER	Volume
Activity	
DISP	950.0
INJ	3100.0
INVCL	100.0
INVOP	100.0
PLTUSE	140.0
REC	40720.0

Report Cancel

Menu-Inbox-Help-Contacts-Logout
Top-AB

2) Facility Activity View: Filter "All"



Menu Inbox Help Contacts Logout AB BA: Name: Quicklist:

[Monthly Reporting] > [Volumetric]

Query Volumetric Submission

Facility ID: AB IF 0000003 **Location:** 00-00-00-000-00 W4 **Production Month:** 2012-09

Name: SAMPLE SCHEME **Amendment #:** 1

Reference Code: ABIF0000003 **Submitted:** 2012-10-18 15:54

ERCB Extracted: 2012-10-19 19:14

View: Facility Activity

Filters: **Activity** ALL **Product** ALL **From/To** ALL Go

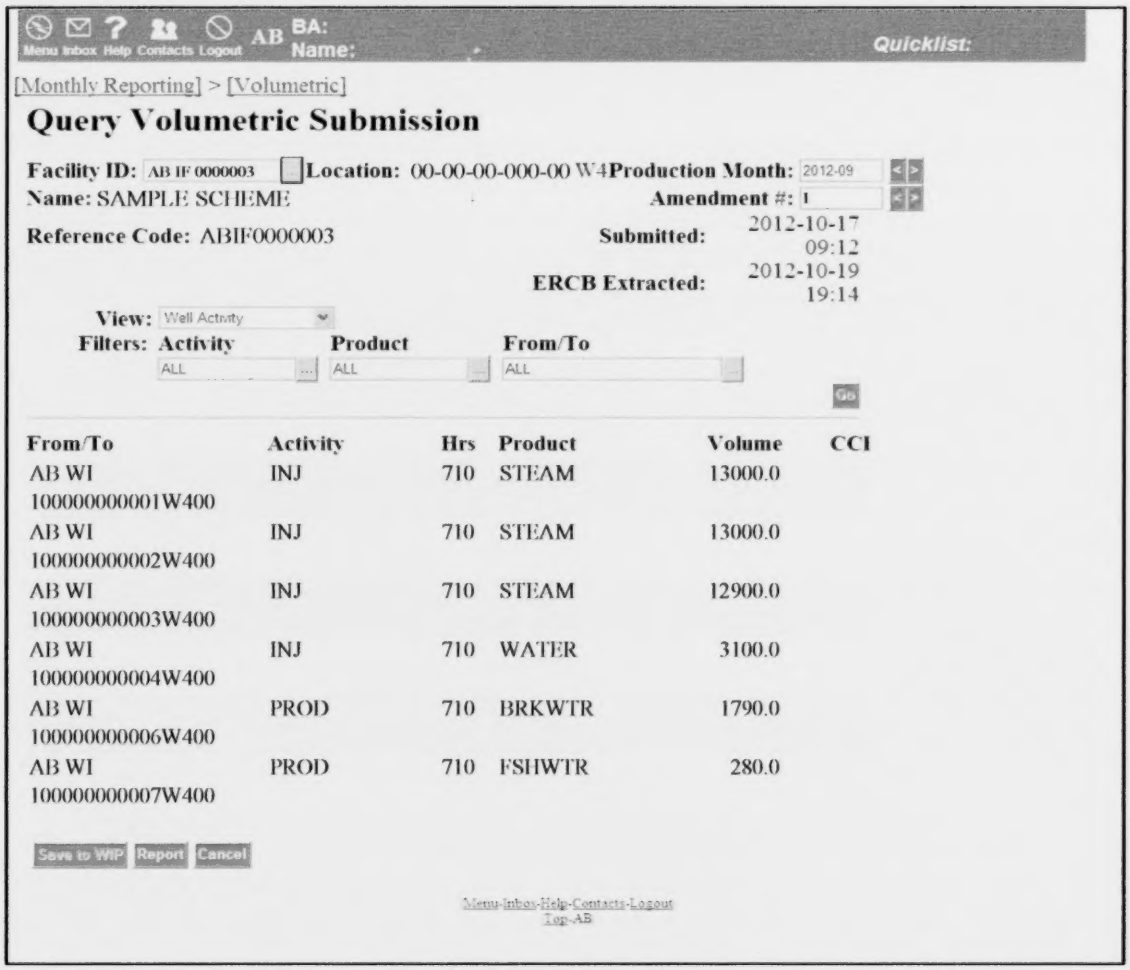
Save to WIP Report Cancel

Activity	Product	From/To	Volume	Energy
REC	WATER	AB BT 0000001	40720.0	
DISP	WATER	AB IF 0000002	950.0	
PLTUSE	WATER		140.0	
REC	FSHWTR	AB RO	180.0	
REC	FSHWTR	AB WS 0000004	1000.0	
REC	FSHWTR	AB BT 0000005	500.0	
PLTUSE	FSHWTR		500.0	
DISP	STEAM	AB BT 0000001	2000.0	
REC	BRKWTR	AB BT 0000005	1420.0	
PLTUSE	BRKWTR		300.0	

Save to WIP Report Cancel

Menu-Inbox-Help-Contacts-Logout
Top-AB

3) Well Activity View: Filter "All"



Menu Inbox Help Contacts Logout AB BA: Name: Quicklist:

[Monthly Reporting] > [Volumetric]

Query Volumetric Submission

Facility ID: AB IF 0000003 **Location:** 00-00-00-000-00 W4 **Production Month:** 2012-09

Name: SAMPLE SCHEME **Amendment #:** 1

Reference Code: ABIF0000003 **Submitted:** 2012-10-17 09:12

ERCB Extracted: 2012-10-19 19:14

View: Well Activity

Filters: **Activity** ALL **Product** ALL **From/To** ALL Go

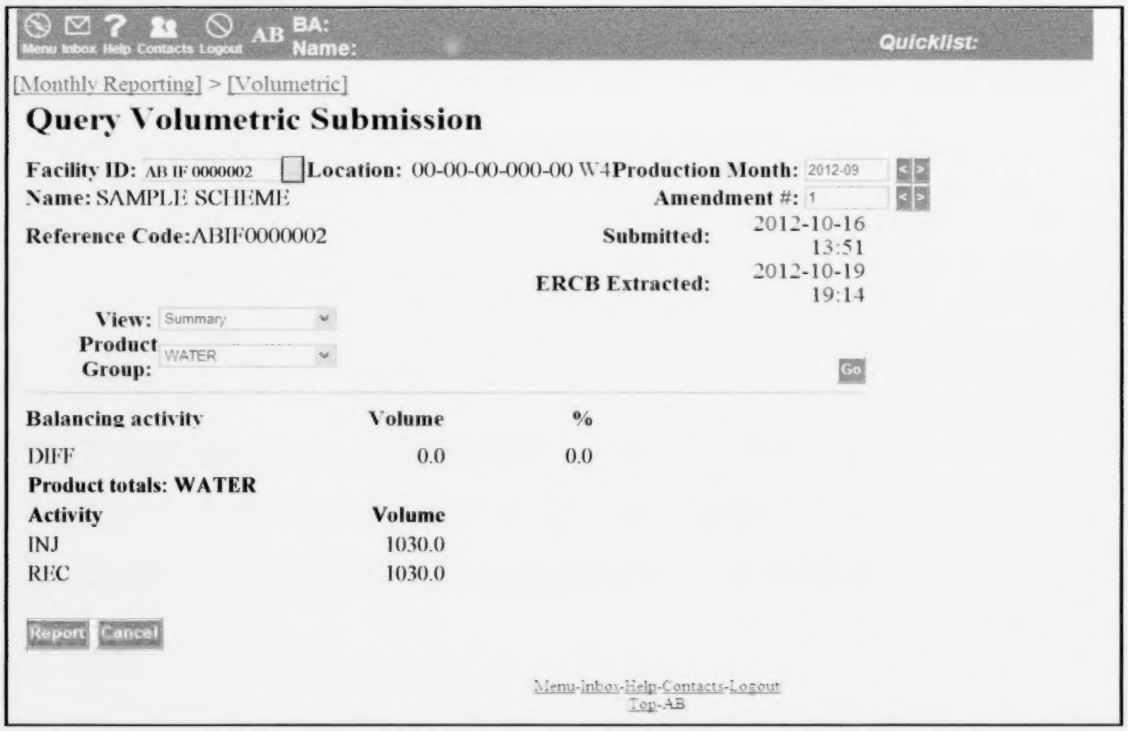
From/To	Activity	Hrs	Product	Volume	CCI
AB WI 100000000001W400	INJ	710	STEAM	13000.0	
AB WI 100000000002W400	INJ	710	STEAM	13000.0	
AB WI 100000000003W400	INJ	710	STEAM	12900.0	
AB WI 100000000004W400	INJ	710	WATER	3100.0	
AB WI 100000000006W400	PROD	710	BRKWTR	1790.0	
AB WI 100000000007W400	PROD	710	FSHWTR	280.0	

Save to WIP Report Cancel

Menu-Inbox-Help-Contacts-Logout
Top-AB

Sample Scheme: Disposal Facility AB IF 0000002

4) Summary View: Product Group "Water"



Menu Inbox Help Contacts Logout AB BA: Name: Quicklist:

[Monthly Reporting] > [Volumetric]

Query Volumetric Submission

Facility ID: AB IF 0000002 **Location:** 00-00-00-000-00 W4 **Production Month:** 2012-09

Name: SAMPLE SCHEME **Amendment #:** 1

Reference Code: ABIF0000002 **Submitted:** 2012-10-16 13:51

ERCB Extracted: 2012-10-19 19:14

View: Summary

Product Group: WATER Go

Balancing activity	Volume	%
DIFF	0.0	0.0

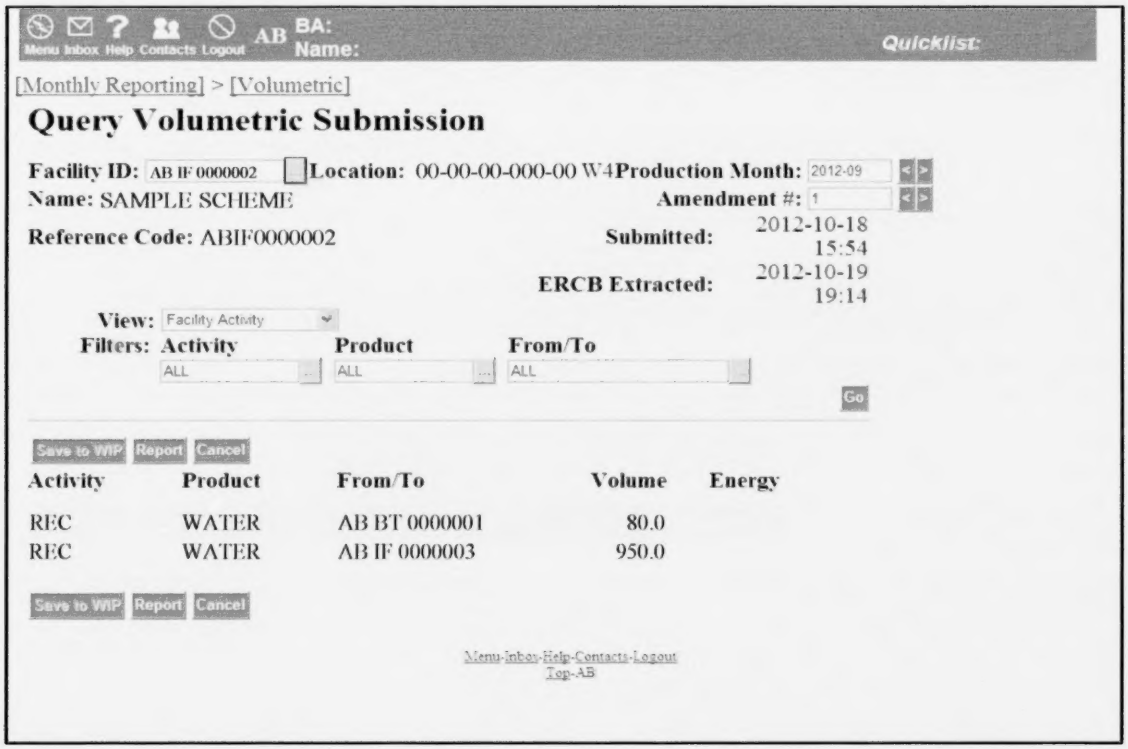
Product totals: WATER

Activity	Volume
INJ	1030.0
REC	1030.0

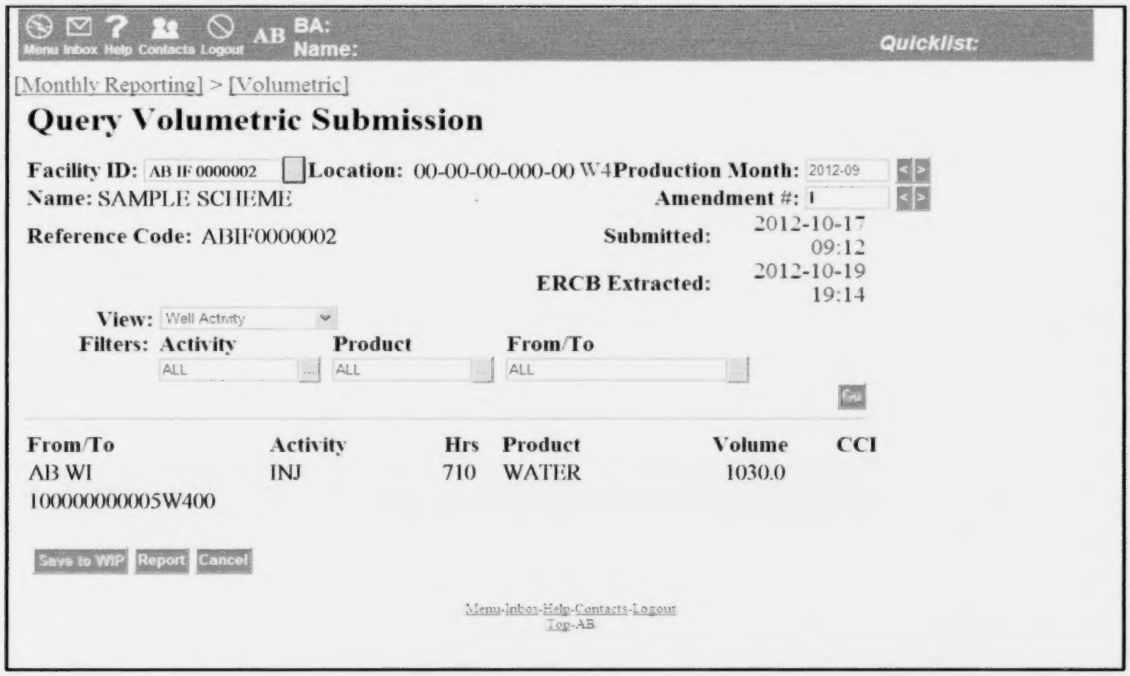
Report Cancel

Menu-Inbox-Help-Contacts-Logout
Top-AB

5) Facility Activity View: Filter "All"



6) Well Activity View: Filter "All"



Appendix G Sample Scheme Facilities Monthly Water Balance

Water stream	ERCB water balance code	Injection facility (steam plant) AB IF 0000003	Injection facility (disposal) AB IF 0000002
IN			
Fresh	FW1	1 960	
Fresh transfer*	FW2		0
Brackish	BW1	3 210	
Brackish transfer*	BW2		0
Produced	PW1	40 720	80
Produced transfer*	PW2		950
OUT			
Inject total	INT	38 900	
Disposal total	DIT	3 100	1030
Fresh PLTUSE	FW6	500	
Fresh transfer*	FW3	0	
Fresh UTIL	FW7	0	
Brackish PLTUSE	BW6	300	
Brackish transfer*	BW3	0	
Brackish UTIL	BW7	0	
Produced PLTUSE	PW6	140	
Produced transfer*	PW3	950	
Produced UTIL	PW7	0	
Produced steam/water to ABBT	PW8	2 000	
Inventory			
Fresh open	FW4	100	
Fresh close	FW5	100	
Brackish open	BW4	100	
Brackish close	BW5	100	
Produced open	PW4	100	
Produced close	PW5	100	
Facility Water Balance			
IN		46190	1030
OUT		46190	1030
Adjustment		0	0
Imbalance		0%	0%

* transferred to or from another injection facility within the scheme

Appendix H Additional Scheme Performance Indicators using ERCB Water Balance Codes

The ERCB uses the following formulas to assess scheme performance and to compare schemes. If multiple injection or disposal facilities exist within a scheme, values for all facilities must be summed. (e.g., BW1 = $\sum$ BW1 for all injection facilities).

1) Freshwater Productivity Ratio

$$\frac{(FW1 + FW4 - FW5)}{\text{Bitumen Production}}$$

2) Brackish-Water Productivity Ratio

$$\frac{(BW1 + BW4 - BW5)}{\text{Bitumen Production}}$$

3) Disposal Ratio

$$\frac{DIT}{\text{Bitumen Production}}$$

4) Freshwater Make-up (%)

$$\frac{(FW1 + FW4 - FW5)}{(INT + DIT)} \times 100$$

5) Brackish-Water Make-up (%)

$$\frac{(BW1 + BW4 - BW5)}{(INT + DIT)} \times 100$$

6) Produced-Water Recycle (%)

$$\frac{[(PW1 + PW4 - PW5 - PW8) - DIT]}{(PW1 + PW4 - PW5 - PW8)} \times 100$$

The above formula for produced-water recycle assumes that all disposal (DIT) is from the produced-water streams. Since make-up water in the disposal stream is expected to be small and is usually not possible to track, this formula is a good approximation of the minimum produced-water recycle.